Astrophysics Research And Analysis

Optimization of the GRAPE Polarimeter Design

Completed Technology Project (2016 - 2017)

Project Introduction

The Gamma Ray Polarimeter Experiment (GRAPE) is designed to investigate one of the most exotic phenomena in the universe – gamma-ray bursts (GRB). There has been intense observational and theoretical research in recent years, but research in this area has been largely focused on studies of time histories, spectra, and spatial distributions. Theoretical models show that a more complete understanding of the inner structure of GRBs, including the geometry and physical processes close to the central engine, requires the exploitation of gamma-ray polarimetry. Over the past several years, we have developed the GRAPE instrument to measure the polarization of gamma-rays from GRBs over the energy range of 50 to 500 keV. The GRAPE design is a modular one in which several independent modules are required to achieve sufficient sensitivity. A single module fits on the front end of a 2-inch square flat-panel multi-anode photomultiplier tube (MAPMT). The first operational balloon flight took in place in September of 2011 from Ft. Sumner, NM. The purpose of the 2011 flight was to validate the science capability of GRAPE by measuring the Crab polarization with a collimated array of 16 modules. The limited success of that flight led to a second validation flight (also from Ft. Sumner) in the fall of 2014, with significantly improved shielding and a larger array of modules. That flight proved too short to make a full observation of the Crab. Although we did not succeed in measuring the polarization of the Crab with a high degree of confidence, we feel that we are nonetheless prepared to move forward with our program. Our next goal is to fly GRAPE on a long duration balloon (LDB) platform to collect data on a significant sample of GRBs. Our experience with the first two balloon flights, coupled with further design efforts focused on orbital payloads, has led to an improved polarimeter concept that represents a natural evolution of the current design. It is this new concept that we are now proposing to develop and test before embarking on a long-duration balloon program. This new design, with improved sensitivity, will ensure that the science objectives can be achieved within the context of a viable balloon program.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

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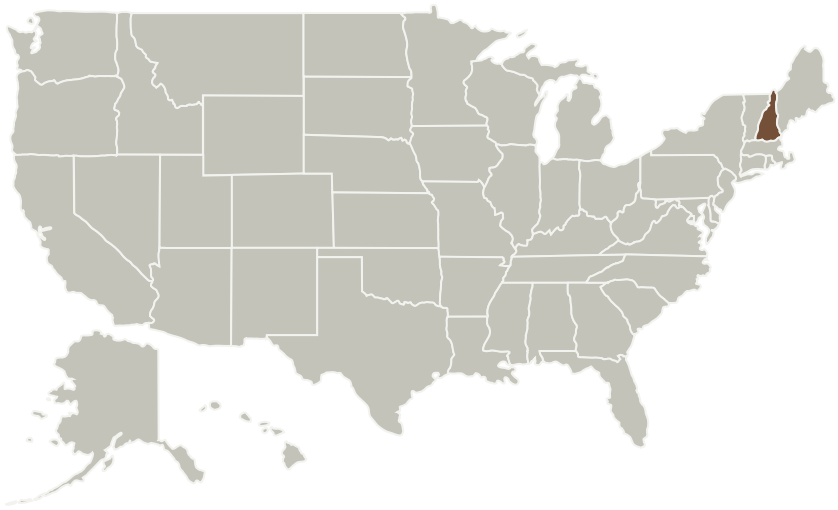
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of New Hampshire-Main Campus	Supporting Organization	Academia	Durham, New Hampshire

Primary U.S. Work Locations
New Hampshire

Project Management

Program Director:
Michael A Garcia

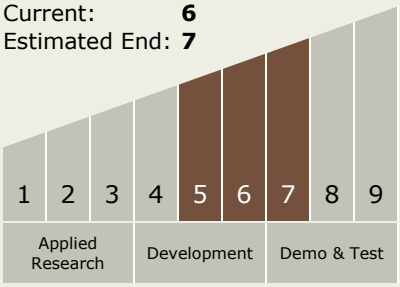
Program Manager:
Dominic J Benford

Principal Investigator:
Mark Mcconnell

Co-Investigators:
Lisa Scigliano
Peter F Bloser
Jason S Legere

Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **7**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System